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ABSTRACT

The purpose of the study described here was to identify indices of state efforts to promote equal opportunity in higher education that might have influenced state appropriations. In addition, an attempt was made to discover common economic and demographic characteristics of the 50 states that appear to influence state egalitarian efforts. The models that resulted are based on human capital theory and created by multiple regression analysis. They explain the relationships between state economic, demographic, and policy action characteristics and the level of state financial investment in higher education for fiscal year 1968-69 and were tested on data from later years. Several data charts are appended, and a brief bibliography is included. (MSE)

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THE IMPACT OF A TASTE FOR EQUAL OPPORTUNITY

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Abstract

This study developed several equal opportunity concern models with which to forecast levels of state and local government investment in higher education. Based upon human capital theory and developed by multiple regression analysis, the models explain over 65 percent of the variance of the relationships between state economics, demographics, and policy action characteristics. In addition to examining variables employed by previous investment studies, variables from individual and aggregate demand and enrollment studies were also considered.

INTRODUCTION

Statement of the Problem

The problem of this study was to identify various indices of state efforts to promote increased participation in higher education which might have influenced the amount of money which the various states were spending on higher education. In addition, an attempt was made to discover common economic and demographic characteristics of the fifty states which appeared to influence egalitarian efforts of the different states.

Significance of the Problem

Considerable debate has taken place recently over the proportion of funds which state and local governments should provide toward the cost of undergraduate education for individual citizens (Carnegie Commission, 1973b, 1974; Committee for Economic Development, 1973; Young, 1974). There appears to be general agreement that the allocation of costs between students and society (i.e. government) should be related to the benefits from higher education (Bowen & Servelle, 1972). Disagreement centers on the amount of individual and social benefits which result from attendance at an institution of postsecondary education. The fact that all state governments and some local governments appropriate funds so that institutions of higher education may charge below-cost tuition to students implies that certain consumers may not otherwise buy an amount of higher education that is

thought to be good for them in the long run (Peltzman, 1971, p. 1). In addition to stimulating individual demand and increasing potential social benefits, it has been suggested that governmental support of higher education may also be given to widen the distribution of the higher education experience or to alter the distribution of individual incomes in the society at large, (Bowen & Servelle, 1972, pp.12, 13).

The particular attention which has been devoted to our national commitment to universal access to higher education is not hard to document. In a comprehensive review of major national and state goal formulations for higher education during the last twenty-five years, Trivett (1973) concluded that:

> The goal of extended access or equality of opportunity for higher education has been central to all goal statements since its proclamation in 1947. ....(In fact) most of the subgoals enunciated over the years can be interpreted in view of the access goal (p. 54).

In the beginning of The Second Newman Report the observation is offered that the United States has recently entered the third major era of social purpose in higher education--the egalitarian period (Special Task Force, 1973, p. 2).

This great volume of rhetoric concerning egalitarian goals has not necessarily meant a correspondingly great achievement. In assessing the five major purposes of higher education, the Carnegie Commission on Higher Education (1973c)

stated the belief that performance had been least adequate in the area of educational justice (p. 54). The primary responsibility for making opportunities in postsecondary education available to all citizens who are interested and capable of benefiting from it rests with the states alone, both constitutionally and historically (Task Force on Coordination, 1973, p. v); for this reason it is important to investigate state efforts to provide universal access to higher education. The fact that access rates differ by states and by personal characteristics has been documented by the Newman Commission (Special Task Force, 1973, p. 3) and the Carnegie Commission on Higher Education (1971a). The existence of barriers to universal access has been investigated in individual case studies and in particular states, but seldom with regard to how such limits relate to state and local expenditure levels. It is the goal of this study to do just that.

REVIEW OF RELATED LITERATURE

In order to enhance the efforts of this study to discover the egalitarian efforts of states which effect expenditures for higher education, a review of previous research was conducted on the following topics: barriers which retard individual attendance at a postsecondary institution; models which have been used to predict the aggregate demand for higher education; and models which have been tested to predict state and local investment in higher education.

After reviewing case studies on the impediments that individuals experience in considering enrollment in higher education over the past thirty years, Ferrin (1970) said that, in general, the barriers identified appear to fall into four basic categories: financial, academic, motivational, and geographic (p. 3).

With an additional perspective of four more years of research studies to his advantage, Halstead (1974) draws very nearly the same conclusion:

> The reasons young people with college ability do not obtain a postsecondary education are numerous and well known. The major factors involved are:
>
> 1. Restricted access because of social and economic class status, religion, race, or ethnic origin;
> 2. Differences in motivation, values, and attitudes resulting from parental or peer group influence and other socio-economic circumstances;

3. Inadequate academic preparation and/or in-school guidance; and
4. Unavailable or inadequate college programs--the deficiency may be in content, level, quality, or geographical accessibility (p. 129).

In the following paragraphs a brief synopsis is given of the many studies which have demonstrated the salience of personal characteristics in determining whether students will enroll in college or not.

Academic Aptitude and Ability

A number of the research studies discuss how socio-economic factors nurture an academic motivation or aptitude (Baird, 1967; Sewell & Shah, 1968; Flanagan & Cooley, 1966; Tillery, 1973). A thoughtful discussion of the importance of motivation to college aspiration can be found in Trent (1970). External evidence of college aptitude and ability are generally assumed to be given by high school graduation and the rank in class upon finishing. Use of the completion of secondary school as a minimum standard for including students in research on factors influencing college attendance is almost universal (Anderson, Bowman, & Tinto, 1972; Froomkin, 1969; Tuckman & Ford, 1972). Although this study was limited to students who have completed high school, recent evidence demonstrated the success of high school dropouts in attending community colleges (Brossman, 1973).

Sex

After reviewing many research efforts concerning the influence of personal characteristics upon college enrollment, Trent (1970) noted that:

> The relationship between socioeconomic status and college entrance varies by sex. Caucasian men of high socioeconomic status are most likely to enter college, particularly if they receive high grades in high school. High ability and high socioeconomic status women differ only negligibly from the men in this respect, but when achievement is not exceptionally high, proportionally fewer women than men enter college, particularly at the lower levels of socioeconomic status (p. 2).

A more recent appraisal of the tendency of women to enroll in various kinds of colleges in comparison to men was provided by Fenske and Scott (1973). After examining over half a million student records made available by the American College Testing Program for the years 1968, 1970, and 1972, the authors observed an overall increase in female attendance from 46.1 percent in the first year to 49.4 percent in the last year.

Many state higher education planning documents also contain descriptions of the sex related attendance patterns within state institutions. One such report has been recently published by the State of New Hampshire (Sackett, 1973). By using an enrollment demand model designed specifically for the state to show sex and income differences in atten-

dance as a result of varying tuition levels, females were viewed as much more sensitive to financial changes than males (p. 41).

Minorities

Membership in a racial minority has been shown to be a barrier to participation in higher education. Whether one looks at state level data or national trends, underrepresentation of Blacks, Chicanos, Puerto Ricans, and American Indians is evident.

In the last report of the California Legislature's Joint Committee on the Master Plan for Higher Education (1973) prior to becoming the Joint Committee on Postsecondary Education, clear statistics were given on the representation of various ethnic groups (Blacks, Mexican-Americans, Asian-Americans, Native-Americans, other minorities, and whites) in the total state population, high school classes, and in the student bodies of the University of California, the California State University and Colleges, and in the California Community Colleges. The barriers to attendance implied by these figures led the Joint Committee to recommend that "each segment of California public higher education shall strive to approximate by 1980 the general ethnic, sexual, and economic composition of the recent California high school graduates." (p. 41)

Authors of a recent progress report on the Regents 1972 Statewide Plan for the Development of Postsecondary Education pointed with pride to the fact that New York appeared to be leading the nation in providing post high school opportunities

for members of ethnic minorities (University of the State of New York, 1974). They stated that while in 1970 the U. S. Bureau of the Census indicated that approximately 14.1 percent of the normal college-going age population in New York State were members of a minority group, the collegiate institutions submitting 1974 progress reports indicated that 16.5 percent of their fall 1973 full-time freshmen were minority group members (p. 5).

Many studies have employed a national sampling to study the issue of barriers to minority enrollment in higher education. One of the earlier research studies was conducted by Bayer and Boruch (1969) for the American Council on Education. They reported that in 1966 less than 6 percent of all students enrolled in colleges were Black, in contrast to 12 percent of the college age population being Black (p. 1).

As a prelude to discussing a framework for analyzing national policies for funding postsecondary education, the National Commission on the Financing of Postsecondary Education (1973) examined current census data. Upon evaluating the figures for residents 18-24 years of age by ethnic group, the Commission noted that:

> American Indians and persons of Mexican parentage or birth have the lowest participation rate of any ethnic group. Over 80 percent of persons in these groups who were between 18 and 24 were not enrolled and had not had any collegiate education. The figures for Blacks were approximately the same, while persons of Japanese and Chinese decent were found to have extraordinarily high participation rates (pp. 144-146).

Proximity

The research report Where Colleges Are and Who Attends by Anderson, Bowman, and Tinto (1972) considered at length the importance of geographical proximity of a college upon attendance. In addition to reviewing most of the studies on geographical determinants that have been written in the past fifty years, the authors analyzed extensive data on high school students in five states (Wisconsin, California, Illinois, North Carolina, and Massachusetts).

Benefits: Public and Private

A basic assumption of studies which intend to develop estimates of the level of interest (demand) by citizens within a given geographical area for enrolling in an institution of higher education is that an individual considers such an enrollment in light of expected benefits and costs (Campbell & Siegal, 1967). The benefits and costs may be immediate or long-term in nature and they may be private or public. Estimates of demand which are based upon weighing the net value of immediate goods and services consumed are known as consumer decision analyses, while those assessments of delayed cost-benefits are referred to as human capital investment studies. The major difficulty in making either type of estimate is the quantification of the value of expended resources and received benefits.

One of the first efforts to calculate private and social rates of return appeared in Becker's book, Human Capital (1964).

In calculating costs to students and their families he included forgone income as a cost in arriving at private rates of return of 14.5 percent in 1939 and 12.7 percent in 1949 for white males. He determined social rates of return to be 13 percent in 1939 and 12.5 percent in 1949. Ethnic and rural backgrounds, as well as the sex of the person, were shown to affect the subsequent earnings of students. Other studies of the rate of return for a college education conducted by Hansen (1963), Weisbrod (1962), and Taubman and Wales (1974) have obtained results in substantial agreement with Becker's findings. Such a generalization was made in light of proper consideration for that fact that neither Hansen nor Weisbrod allowed for differences in native ability and family background.

Enrollment Demand Models

Thus far the concern has been to understand the factors which determine the actions of an individual with regard to his or her enrollment in a higher education institution. However, governmental units are interested in aggregate measurements of the demand by its citizenry for higher education. During the past decade a number of efforts have been made to provide that information.

One of the first enrollment demand models was developed by Campbell and Siegal (1967). They claimed that 87 percent of the variation in enrollments could be explained by using only the price of the good (tuition) and personal income available (p. 482).

Higher education demand models which considered a much larger range of socioeconomic and demographic factors have emerged since the 1967 Campbell and Siegal study, but they were cross-sectional approaches rather than time-series analyses. In a study presented to the Joint Economic Committee of Congress, Feldman and Hoenack (1969) offered an estimating procedure for private demand for higher education in the year 1963, a year in which the influence of the draft on college attendance probably did not vary much among the states. Variables which were employed in the model included: tuition at each type of institution (four-year public, four-year private, two-year public); geographical proximity of state's population to each type of school; labor market earnings and unemployment duration rates; performance on test scores; urban-rural population composition; education of parents as a proxy for family income; and regional (i.e. Northeast, South, etc.) dummy variables. Although the authors expressed monetary costs exclusive of foregone income, it is very apparent from their data that a $100 increase in tuition made a substantially depressing effect (up to nine percent) on enrollment levels.

Carlson, Weathersby and Farmer (1974), in a staff report for the National Commission on the Financing of Postsecondary Education, A Framework for Analyzing Postsecondary Education Financing Policies, employed price response coefficients derived from the Radner and Miller (1975) study to develop a model for relating a large number of financing policy variables

to quantitative measures of the degree of achievement of postsecondary educational objectives (p. 52). In addition, the staff report contains a short description of four other research studies on price response coefficients (Kohn, Manski, & Mundel, Note 1; Barnes, etal., Note 2; Carrazzini, Dugan, & Grabowski, 1973; Hoenack & Weiler, 1973). Carlson, Weathersby & Farmer concluded that:

> The (price response) studies indicate that the proportion of the eligible population attending college or that the probability an individual attends college increases with family income and decreases with the cost of attendance (defined in a number of ways) (p. 157).

Furthermore:

> Some rough calculations (on the data from the studies) indicate that the price response coefficients range between one and five percent for a $100 change in price (p. 159).

In a recent study intended to measure the effect of government subsidies through uniformly low public tuition or through direct payments to certain students, Peltzman (1971) concluded that three-fourths of government expenditures substitute for private expenditures. Although Peltzman did not find urbanization or ethnic composition of the population to be significant influences on the price elasticities of public or private institutions, he did obtain significant results by including personal income, government revenues, ratio of median income of college graduates to high school graduates, fraction of households with income over $10,000 and the net migration of students.

The review of past research which was presented in this chapter suggests that barriers to college attendance for an individual student include low family income level, poor rank in the high school graduating class, residence in a rural area or community not in close proximity to a college or university, membership in a racial minority, and being a female.

In addition, previous studies of aggregate demand models suggested the importance of family income levels, labor market earnings and unemployment, student abilities, college proximity, urbanization, and region of the country.

Finally, the prior models for explaining state and local investment in higher education attributed significant roles to personal income, governmental revenues, median income of college graduates versus high school graduates, and net migration of students.

CONCEPTUAL FRAMEWORK AND RESEARCH DESIGN

This research effort was based on an examination of the importance and interrelationships of several different conceptual systems: (1) public investment in higher education as human capital; (2) the academic market equilibrium between potential students and institutions in light of special concern for equal educational opportunities; and (3) the individual decision to go to college. Consideration was given to these conceptual frameworks according to the stated order. First, the work of Walter McMahon (1974) was utilized to establish the basic model for state and local investment in

higher education. Next, primary egalitarian effort measures were chosen for inclusion in the model by referring to the research of Willingham (1970), Ferrin (1970), Harris (1962), Shenker (Note 3), Weld (1972), and Halstead (1974) on enrollment barriers of importance to individuals and institutions. Finally, socioeconomic and demographic factors, which could theoretically and statistically complement the egalitarian effort measures in the explanation and/or prediction of state and local investment in higher education, were selected from several attempts which had been made to build a model for the college attendance decision making process. The interdependence of these conceptual systems is demonstrated by the exact components of the public investment model presented at the conclusion of this report.

In moving from a general state and local investment decision model to a special equal opportunity model a shift may be necessary from employing almost entirely aggregate economic variables to a broader mix of demographic and economic factors. The construction of a new investment paradigm focusing on the provision of equal educational opportunities needs to be hypothesized and tested. The end of this process should provide state level decision makers with a better understanding of the relationships between societal characteristics and particular policy actions.

A public investment model, empirically tested by McMahon (1974) for predicting state and local expenditures for higher education while attempting to include a rough esti-

mate of the desire to provide equal educational opportunities, constitutes the specific theoretical framework for this research effort. Within this model the main economic determinants considered were current income, expected returns, interest rates, and an index of desires for equity in educational opportunity.

Current income was believed to be a theoretically acceptable determinant on the assumption that there are imperfect capital markets for financing educational capital so that larger family income lowers the financing costs (McMahon, 1974, p.2). The effect of expected financial returns and of interest costs have been shown to be important through the work of Freeman (1971). The desire for greater equality was noted as a potential determinant of effective demand for public investment in higher education in the literature of public expenditure development, such as in Musgrave (1969). McMahon maintained that the demographic influence, the proportion of the population of college age, can be logically expected to have an effect on each family's investment decision, as well as on the political pressures parents bring on state and local legislatures and Congress (McMahon, 1974, p. 3).

To be more precise, McMahon hypothesized that the amount of investment in higher education is a function of per capita income, the college age population, the price of attendance, real future income added, the stock of human capital which is 14 years or older with at least one year of college attendance, and a measure of the public taste for equal opportunity provision--the Gini coefficient of income inequality (p. 83). In obtaining

a total coefficient of multiple determination (R^2-- the amount of variation of the dependent variable accounted for by the independent variables employed in the model) of .927 for public institutions and an R^2 of .971 for private institutions, McMahon discovered that the most important determinant is current real personal income, followed by the size of the college population (p. 85). The price of attendance was significant and positively associated with larger state and local investment (p. 89). Expected real future income per young adult specifically attributable to higher education did not prove significant when introduced (p. 89). The inequality coefficient was positively associated with state investment at public and private universities as expected, but the relationship was not a strong one (p. 89). The stock of human capital formed through higher education had a negative coefficient consistent with expectations (p. 89), i.e. the greater the amount of educational capital developed the less there is a need for further education.

Phase One

The first phase of the research consisted of stepwise, multivariate regression analyses of data (for public and private institutions in all fifty states, for fiscal year 1968-69) which was used to develop a state and local higher education investment model. Five different measures (the original McMahon Gini coefficient and four substitutes) of societal egalitarian efforts were separately tested for their contribution to the prediction successs of the model:

1. The proportion of a state's population within commuting distance of free-access colleges or universities (FATP), the latter as defined by Willingham (1970, pp. 184 - 195);

2. The proportion of a state's non-white population within commuting distance of free-access institutions (FANW) as determined by Willingham (1970,pp. 194 - 195);

3. The full-time equivalent enrollment as a percent of the college age population (18-24 years in age) (ENCA);

4. The revenues of state and local governments per person of college age (RPCA).

The efforts of Willingham (1970) and Ferrin (1971) in determining the supply of free-access colleges and universities (the first and second egalitarian measures) have been lauded and utilized by the National Commission for Financing Post-secondary Education (1973), the Carnegie Commission on Higher Education (1971 a) and Halstead (1974). The work of Willingham on free-access colleges and universities incorporated successfully both individual demand components and aggregate institutional supply dimensions. Free-access schools were selected for this study because they possess attributes which greatly diminish three widely recognized barriers to universal proximity.

The third measure of states' egalitarian efforts, the full-time equivalent enrollment as a percent of the college age population (ENCA), had been employed in exact or similar forms by Harris (1962), Mushkin (1962), Shenker (Note 3), Weld (1972), and Halstead (1974) as an important comparative index. Connecticut is an example of at least one state which

had also utilized this measure (Connecticut Commission, 1974).

The fourth and final measure of states' egalitarian efforts, the revenues of state and local governments per person of college age (RPCA), had been used in exact or similar forms by Harris (1962), Mushkin (1962), Gregory (1967), Shenker (1969), and the higher education coordination board of Louisiana (Louisiana Coordination, 1972).

Consideration was given to various statistical methods which would permit the exploration of the relationships of equal opportunity variables with component variables of prior state and local investment prediction models. The use of stepwise, mutivariate analysis permitted the statistical assessment of the contribution of the alternative measures of egalitarian efforts to the dependent variable (i.e. state and local investment in higher education) prior to the utilization of other variables from the original McMahon model. The purpose of this process was to assess whether any individual or combination of the five measures of egalitarian efforts were better determinants of investment than any of the initial economic or demographic variables. Should all four of the egalitarian measures have proved themselves to be statistically non-significant contributors to the model, several alternative measures were available as substitutes for real personal income and for college age population. The equality measure of income distribution, the Gini coefficient, was used as a useful surrogate of income when employed simultaneously with one or more of the trial egalitarian measures. In the same manner, non-white college age population was considered a better

demographic surrogate in combination with one of the trial egalitarian measures than the original variable, college age population.

Phase Two

The second phase of the research centered on selection of economic and demographic characteristics of the states which were to enhance the new "egalitarian" investment prediction models developed in the first phase of the research. This was accomplished by simultaneously regressing all economic and demographic variables at the same time as the phase one variables. The variables which were tested were selected on the basis of demonstrated promise as a result of past research efforts. These factors included sex of the college age population, non-white proportion of the college age population, the number of high school graduates as a percent of 18 year olds, the proportion of federal aid per person of college age, the net migration rate as a percent of the college age population, urbanization, population density, and the region where the state was located. The original model by McMahon does not utilize these variables, nor was there evidence that they were tested and discarded.

Limitations

To insure proper interpretation by the reader of the data which were gathered and analyzed it is important to cite their restrictions:

1. State and local expenditures do not include estimates for services which institutions were provided but for which no payment was made;

2. While many studies have examined only expenditures for public institutions, this study includes private institutions as well, since thirty-nine of the states provided some form of aid to non-public institutions (Millard, 1974);

3. At the particular time of the study, expenditure data did not include the newest official part of the post-secondary spectrum--proprietary schools--because no useful data were available.

4. This study was a cross-sectional comparison rather than a time-series analysis like that in the original McMahon study. The major reason for this change was that certain types of data, particularly migration data and free-access supply estimates, were not available for every year nor have they been determined since 1968;

5. The selection of the exact range for the college age population was especially difficult because of the variety of figures which have been employed by researchers and state planning agencies for this age group. The choice of the 18-24 year old population was based upon it being about the most prevalent measure in current use, plus the fact that it begins to reflect some of the recent emphasis for students to start later or start, stop out a year or so and then return;

6. Finally, there needs to be a recognition of probable market imperfections. While the exact effect was almost impossible to determine there needs to be a recognition that certain conditions of the market would have reduced the exact correspondence between supply and demand. The major imperfection of concern is the students' lack of information about

the return to educational investment in certain fields or about the availability of capital (Singer & Feldman, 1969).

Since the purpose of this research effort was to assist state level decision makers in gaining a better understanding of the relationship between societal characteristics and particular policy decisions, the reader must keep in mind that decision makers may be able to alter certain economic variables, but be unable to modify social or demographic constraints.

PROCEDURES AND ANALYSIS

This chapter describes the criteria for selecting the independent and dependent variables used in this study, the methods of statistical analysis, and the equal opportunity investment models employed. Later, a description of the full process of data analysis is detailed.

Selection Criteria for Investment Model Indices

The selection of indices for testing in the investment model was based upon an evaluation with regard to the following criteria:

1. An index should have validity, i.e., it should measure what is intended;
2. An index should be reliable;
3. An index should be quantitative rather than judgmental and consist of interval data, if possible;
4. An index should be independent of a state's population size;
5. Data should be available for the year of concern;

6. Previous research should have employed the measure.

Multivariate Regression Analysis

In order to account for the different amounts of funds which state and local governments provided for higher education human capital investment as a result of variations in the economic, demographic, and public policy characteristics of the different states, a series of multivariate regression analyses were conducted. Multiple regression technique permits the researcher to consider simultaneously the distinctive contributions to the dependent variable of a great many environmental factors.

After examining the various methods of multiple regression analysis (forward, backward, stagewise, and stepwise), Draper and Smith (1966) concluded that stepwise regression was the best technique for determining basic models of explanation and prediction (p. 71). McMahon (1974) employed a stepwise, multiple regression analysis to the data for this basic theoretical model upon which this study is based. To facilitate quick and accurate calculations of the multiple regression equations the Statistical Package for the Social Sciences (SPSS) subprogram regression was employed (Nie, Best & Hull, 1970).

Phase One

During phase one of this study a total of eighteen multivariate regression model equations were tested (all variables and equations are given in Table 1).

Insert Table 1 here

These eighteen equations stem from five basic models for predicting the state and local governmental investment in higher education human capital. The five basic models (see below) result from

substituting independent equal opportunity variables in subscript 3; the first basic model is:

(1) $ISL=b_1PCPI +b_2FIA +b_3GINI +b_4TFPE +b_5SHEC +b_6CAPT +a_1 +e_1$

In this model investment in higher education by state and local governments for 1968-69 (ISL) is a function of per capita personal income (PCPI), the real future income added per student (FIA), the coefficient of income inequality (GINI), the tuition and fees paid per full time enrollee (TFPE), the existing stock of higher education capital (SHEC), the college population 18-24 years old (CAPT), plus a constant (a_i), the intercept, and an error term (e_i).

The remaining four basic models are as follows:

(2) $ISL=c_1PCPI +c_2FIA +c_3FATP +c_4TFPE +c_5SHEC +c_6CAPT +a_2 +e_2;$

(3) $ISL=d_1PCPI +d_2FIA +d_3FANW +d_4TFPE +d_5SHEC +d_6CAPT +a_3 +e_3;$

(4) $ISL=f_1PCPI +f_2FIA +f_3ENCA +f_4TFPE +f_5SHEC +f_6CAPT +a_4 +e_4;$

(5) $ISL=g_1PCPI +g_2FIA +g_3RPCA +g_4TFPE +g_5SHEC +g_6CAPT +a_5 +e_5;$

In models (2) through (5) subscript variable 3 changes and includes FATP, the proportion of the state's total population within commuting distance of a free-access college or university; FANW, the percentage of the non-white population of each state within commuting distance of a free-access institution; ENCA, the proportion of the college age population presently enrolled in higher education; and RPCA, the state and local revenue which is available per college age person.

Model and equation (1) above is the basic state and local government investment equation employed by McMahon (1974) in his time-series analysis. This equation has been included in this study to determine its salience relative to cross-sectional data

(measures of the different variables for all the states for the same point in time, fiscal year 1968-69) and to provide easy visual comparison with the other alternative models which are tested. The latter four equations, (2) through (5), represent models which differ in terms of the single, equal opportunity concern variable (FATP, FANW, ENCA, or RPCA); it was hypothesized that any of these four alternative variables could replace the Gini coefficient employed in the first model and thereby improve the predictive power of the basic equation and model.

The improvement was hypothesized on the assumption that the status of a given state's income distribution would be further removed from the thought processes of state and local policy makers than measures of ability, effort, or achievement which were specific to higher education.

The second and third models assumed that indicators of state and local efforts to provide resources to institutions which had minimal requirements for admission were more appropriate for predicting state and local higher education investment levels which related directly to equal educational opportunity concerns than would the use of the Gini coefficient of income inequality. The state and local effort indicators used in equations (2) and (3) were respectively, the proportions of the total population (FATP) and non-white population (FANW) which were within commuting distances of free-access institutions.

The fourth model (and equation) postulated that the present level of achievement of enrollment relative to the state's college age population (ENCA) was more important to higher education investment decisions than the distribution of personal income.

Finally, the fifth model hypothesizes that the revenues which were already available for allocation to higher education by state and local decision makers would be more influential in determining investment policy than the distribution of personal income under individual citizen control.

The remaining thirteen regression equations and models which were tested in phase one represented three series of variations on the basic models. In the first series, equations (6) through (9) included variables that were the same as (2) through (5), except subscript 1 was changed by substituting the Gini coefficient of income inequality (GINI) for per capita personal income (PCPI):

(6) $ISL = h_1 GINI + h_2 FIA + h_3 FATP + h_4 TFPE + h_5 SHEC + h_6 CAPT + a_6 + e_6;$

(7) $ISL = i_1 GINI + i_2 FIA + i_3 FANW + i_4 TFPE + i_5 SHEC + i_6 CAPT + a_7 + e_7;$

(8) $ISL = j_1 GINI + j_2 FIA + j_3 ENCA + j_4 TFPE + j_5 SHEC + j_6 CAPT + a_8 + e_8;$

(9) $ISL = k_1 GINI + k_2 FIA + k_3 RPCA + k_4 TFPE + k_5 SHEC + k_6 CAPT + a_9 + e_9.$

Equations (10) through (14) represent a return to the same subscript variables (1 through 5) as appeared in equations (1) through (5), with (14) being similar to (1).

The central change in this series centers on subscript 6, for which percent of non-white college age population of each state (NWCA) was substituted into the basic equations for percent of total population that is college age (CAPT):

(10) $ISL = l_1 PCPI + l_2 FIA + l_3 FATP + l_4 TFPE + l_5 SHEC + l_6 NWCA + a_{10} + e_{10}$;

(11) $ISL = m_1 PCPI + m_2 FIA + m_3 FANW + m_4 TFPE + m_5 SHEC + m_6 NWCA + a_{11} + e_{11}$;

(12) $ISL = n_1 PCPI + n_2 FIA + n_3 ENCA + n_4 TFPE + n_5 SHEC + n_6 NWCA + a_{12} + e_{12}$;

(13) $ISL = o_1 PCPI + o_2 FIA + o_3 RPCA + o_4 TFPE + o_5 SHEC + o_6 NWCA + a_{13} + e_{13}$;

(14) $ISL = p_1 PCPI + p_2 FIA + p_3 GINI + p_4 TFPE + p_5 SHEC + p_6 NWCA + a_{14} + e_{14}$.

For the third series, equations (15) through (18) kept the subscript 6 variables the same as in the previous series and once again substituted in subscript 1 the Gini coefficient for per capita personal income:

(15) $ISL = q_1 GINI + q_2 FIA + q_3 FATP + q_4 TFPE + q_5 SHEC + q_6 NWCA + a_{15} + e_{15}$;

(16) $ISL = r_1 GINI + r_2 FIA + r_3 FANW + r_4 TFPE + r_5 SHEC + r_6 NWCA + a_{16} + e_{16}$;

(17) $ISL = s_1 GINI + s_2 FIA + s_3 ENCA + s_4 TFPE + s_5 SHEC + s_6 NWCA + a_{17} + e_{17}$;

(18) $ISL = t_1 GINI + t_2 FIA + t_3 RPCA + t_4 TFPE + t_5 SHEC + t_6 NWCA + a_{18} + e_{18}$.

The variations in the last two series of equations were the result of hypothesizing that (a) the Gini coefficient of income inequality (GINI) was a more important surrogate for the state's income level variable in an equal opportunity investment model than the state's per capita personal income (PCPI); (b) the proportion of a state's college age population which is non-white (NWCA) was a more important measure of a state's major demographic characteristics which relate to an equal opportunity

investment model than the proportion of a state's total population which is of college age (CAPT); and, (c) the "best" model will be produced by substituting both the GINI variable for PCPI and the NWCA variable for CAPT.

Phase Two

The phase two of the research centered on those models already tested in which the egalitarian concern measures were statistically significant. Additional demographic and economic variables were analyzed simultaneously with the significant basic models through stepwise regression techniques:

1. Sex distribution of the college age population (SCAP)[1];

2. Non-white college age population as a percent of the total college age population (NWCA)[1];

3. High school graduates as a percent of 18 year olds (HSGP)[1];

4. Federal aid in proportion to the college age population (FACA)[1];

5. Net migration of students in proportion to the college age population (MCAP)[1];

6. The proportion of students remaining in state to the number of college age students residing in the state who enroll in a college or university anywhere (SRSR)[1];

7. Urbanization of the state's population (URBN)[1];

8. Population density of the state (PDS)[1]; and

9. Region of the country where the state belongs[1], using U.S. Census Bureau regional divisions--Northeast, South, North Central and West. The importance of this factor was assessed through a dummy variable technique (Suits, 1957). First, dummy variables were created to demonstrate the possibility of variations in the constants of the multiple regression equations (part one of phase two). The variables used were D^1, D^2, and D^3 (only n - 1 dummy variables are needed in the equation to test for n regions). Next, a test was made for the differences in slopes of the multiple regression equations (part two of phase two). To do this interaction terms between each of the independent variables and each region were necessary. These variables were X20 through X79. Finally, a partial F test was conducted comparing the significance of variances between leading model additive equations which accounted for regional variations in intercepts (constants) versus leading model interactive equations which accounted for regional variations in slopes.

RESULTS AND DISCUSSION

As a prelude to the actual multiple regression analyses, basic descriptive statistics were developed for the individual independent and dependent variables: the mean, the median, the

standard deviation, kurtosis, skewness and range (these statistics are given in Table 2).

Insert Table 2 here

The chief purpose of examining these individual variable statistics was to be alert to extreme instances of kurtosis or skewness, especially among variables appearing as significant in the models which were developed. Thus, variables SCAP, NWCA, FACA, MCAP, PDS, and TFPE may present challenges to the degree of linearity robustness inherent in the SPSS regression analysis.

In addition, the linearity of bivariate distributions between independent variables and the dependent variable were plotted. No apparent nonlinear bivariate distributions were noted. Finally, simple Pearson correlation coefficients were determined for the relationships between each independent variable and the dependent variables and among all pairs of independent variables. The results are provided in table 3.

Insert table 3 here

The purpose of examining simple correlation coefficients is to gauge the strength of the relationship between each independent variable and the dependent variable, as well as look for possible multicollinearity among independent variables employed. In accordance with the guidelines employed by

McMahon (1974) a simple correlation coefficient (r) of .8 or greater will be said to imply multicollinearity, requiring the elimination of one of the pair of variables tested (p. 8). No cases of multicollinearity were apparent. The data in the table of simple correlation coefficients (table 3) indicate the r's which are significantly different from zero using a two-tailed t test.

Multiple Regression Equation Results, Phase One

The results for the eighteen multivariate regression model equations are presented in tables 4 through 12. The first line of data for each model ("Coefficient") in the tables are the regression coefficients (b terms) for all independent variables; the constants (a terms) are also provided. The statistical significance of each independent variable or constant is given in the second line of data for each model ("Significance"); it comes from an F test which takes into consideration the sample size (50) and the degrees of freedom. The use of F tests to gauge the significance of the multiple correlation coefficients has been recommended by Blalock (1960, pp. 354-57) and Hays (1963, p. 573). The SPSS subprogram regression automatically calculates F tests and corresponding significance levels according to sample size and degrees of freedom for R's, b's, and equation constants. A significance level of .05 or less was chosen as reasonably appropriate for this study.

For each model equation a coefficient of multiple correlation (R) is shown as well as a coefficient of multiple determination (R^2). The former statistics indicate the correlation between the set of independent variables in the

equation and the dependent variable. The latter statistic indicates the proportion of the variation in the dependent variable which can be explained by the independent variables in the equation. The results of F tests of the R's are shown directly below the R's.

INSERT TABLES 4 - 7

Data in table 4 display the results for the six variable basic equal opportunity models which differ by employing different individual equal opportunity variables (GINI, FATP, FANW, ENCA, RPCA) for subscript 3 (i.e. column 3 of the data in the table).

Data in table 5 exhibit the results of series one variations of the basic models in which all variables remained the same except that the Gini coefficient of income inequality in each state, GINI, was substituted for the per capita personal income, PCPI, in subscript 1.

Series two variations of the basic equal opportunity models appear in table 6. In subscript 6 of the original model equations the percent of non-white college age population in each state, NWCA, was substituted for the percent of the total population of college age, CAPT.

Finally, the data in table 7 display series three variations of the basic models in which the Gini coefficient of income inequality, GINI, was substituted into subscript 1 for the per capita personal income, PCPI, and the percent of

non-white population in each state, NWCA, was substituted into subscript 6 for the percent of the total population of college age, CAPT.

In tables 8 through 12 all eighteen phase one model equations have been re-grouped according to the particular variations of the basic five models discussed above. The importance of the basic model and the variations are best analyzed by focusing on the statistical significance results for each group of variations. An examination of the results suggests the following group rank order of magnitude for R^2:

RPCA FANW ENCA FATP GINI

INSERT TABLES 8 - 12

Of major interest here are the equations in which these equal opportunity variables were significant; such equations are numbers 3, 4, 5, 7, 9, 11, 12, 13, 16, and 18. All four RPCA model equations (table 12), as well as all four FANW model equations (table 10), have a significant equal opportunity variable. It is obvious in table 8 from the size of the R^2 that the original McMahon model (equation 1) and its alternative form (number 14) were the poorest predictors of the dependent variable.

Multivariate Regression Results--Phase Two

In part one of phase two the equations were tested for regional additive effects upon the independent variables. A test for regional additive effects hypothesizes that independent variables influence the dependent variable in the

four different regions only with regard to the intercepts of the model regression equations. In contrast, tests for regional interactive effects were conducted in part two because an equally plausible hypothesis existed that independent variables interacted with one another differently in the four regions, thus affecting the slopes of the regression equations as well as their intercepts. Regional interactive models not only provide for additive effects of the regions, but also assume that other independent variables provide different predictions of the dependent variable according to the region of the country in which the state is located.

In part one of phase two those equations of phase one which showed significant equal opportunity variables, equations 3, 4, 5, 7, 9, 11, 12, 13, 16, and 18, were each subjected to a simultaneous multivariate regression analysis with seven additional demographic and economic variables and three regional dummy variables.

The results of these analyses are given in tables 13 through 17, grouped according to the common regression equation results obtained. Regressions were limited to a maximum of seven variables and in some cases were stopped prior to this point when additional independent variables could not display a partial F significance value less than or equal to the .05 level to enter the equation.

INSERT TABLES 13 - 17

In part two of phase two all of the same variables used in part one are employed in regression analyses along with interaction terms between each pair of independent variables. The results of these analyses have been given in tables 18 through 21, again grouped according to common regression equation results.

INSERT TABLES 18 - 21

To test the significance of the R^2 differences between non-regional model equations and regional additive models, as well as between regional interactive models and corresponding regional additive models, partial F tests were employed (Lane, 1968). The ratio

$$\frac{R_I^2 - R_A^2}{I - R_I^2} \cdot \frac{N - r - 1}{r - s}$$

is distributed as an F distribution with N - r - 1 degrees of freedom in the numerator, where N equals the number of observations, r is the total number of independent variables used to estimate R_I^2, s is the number of independent variables used to estimate R_A^2, and r - s is the number of independent variables added to estimate R_I^2 over those used to estimate R_A^2.

If the values of F are significant at a given level, one can assume that the differences between the regional additive equations and corresponding non-regional equations (phase one) are not due to sampling error.

Since pairs of phase one equations produce the same regional additive equation, a partial F test was made for the smaller difference in R^2 between any individual equation of the pair and the resulting phase two additive equation. For example, equations 7 and 16 (table 10), produce equation 19 (table 13). The R^2 of equations 7 and 16 are .55554 and .55781. The difference between the R^2 of model equation 19 (.73567) and model equation 16 is smaller than the R^2 difference between equation 19 and 7, and thus provides the more severe test for the pair of equations.

Application of this test to equations 16 and 19 showed that

$$F = \frac{.73567 - .55781}{.26433} \cdot \frac{50 - 9 - 1}{9 - 6} = 8.9665$$

The critical F value at the .05 level is 2.8387, indicating that the phase two additive equation is significantly different from the phase one model equation.

Application of the partial F test to equations 3 and 20 showed that

$$F = \frac{.69613 - .55561}{.30387} \cdot \frac{50 - 9 - 1}{9 - 6} = 6.1657$$

The critical F value at the .05 level is 2.8387, indicating that the phase two regional additive equation is significantly different from the phase one model equation.

For equations 12 and 21 the partial F test showed that

$$F = \frac{.64654 - .55130}{.35346} \cdot \frac{50 - 8 - 1}{8 - 6} = 5.5237$$

The critical F value at the .05 level is 3.2100, indicating that the phase two regional additive equation is significantly different from the phase one equation.

For equations 9 and 22 the partial F test showed that

$$F = \frac{.67340 - .60714}{.32660} \cdot \frac{50 - 9 - 1}{9 - 6} = 2.9050$$

The critical F value at the .05 level is 2.8387, indicating that the phase two regional additive equation is different from the phase one equation.

Finally, a partial F test of equations 18 and 23 showed that

$$F = \frac{.70288 - .60491}{.29612} \cdot \frac{50 - 11 - 1}{11 - 6} = 2.5140$$

The critical F value at the .05 level is 2.4600 indicating that once again the phase two regional additive equation is significantly different from the phase one equation. Thus for those regional additive equations specifying a specific region (equations 20, 22 and 23) the regional variables are significant predictors of the dependent variable.

Significant F values of R^2 differences between the interactive regression equations and the corresponding additive equations also allow one to conclude that the results are not due to sampling error.

Application of this test to compare additive regional equation 19 and interactive regional equation 24, FANW, showed that

$$F = \frac{.73902 - .73567}{.26098} \cdot \frac{50 - 8 - 1}{8 - 7} = .526$$

The critical F value at the .05 level is 4.085, indicating that the difference between the R^2's of equations 19 and 24 could be due to random chance.

For additive regional equation 20 and interactive regional equation 25, FANW,

$$F = \frac{.72884 - .69613}{.27116} \cdot \frac{50 - 8 - 1}{8 - 6} = 2.4727$$

The critical F value at the .05 level is 3.232. So, the difference between the R^2's could be due to random chance. For equation 21, ENCA, there were no differences between regional additive and regional interactive equations. Furthermore, ENCA does not appear in the equations. Hence, there is no further consideration of equation 21.

For additive regional equation 22 and interactive regional equation 27, RPCA,

$$F = \frac{.72399 - .67340}{.27611} \cdot \frac{50 - 9 - 1}{9 - 5} = 1.8322$$

The critical F value at the .05 level is 2.6060. Again, differences between the R^2's could be due to random chance. The equal opportunity variable in equation 23, RPCA, was not significant so the equation was not considered further for comparison.

The results of partial F tests comparing all regional variations of the equal opportunity models suggest that region of the country is a predictor of the dependent variable, but that other independent variables do not predict with significant differences in the four regions. Thus model

equations 24, 25, 26, and 27 are excluded from further consideration.

An effort was made at this point in the study to produce one "best" model by performing a multivariate regression analysis using all the variables of the remaining three equal opportunity models (19, 20, and 22). The resulting combination equation (table 22) does have an R^2 greater than the other three regional additive models. A regional interactive model equation was also created through regression analysis for this "best" model. The results in table 23 show an R^2 that is larger than those obtained for the other regional interactive models.

A partial F test comparing the regional interactive and regional additive versions of the "best" model showed no significant difference:

$$F = \frac{.76982 - .73567}{.23018} \cdot \frac{50 - 9 - 1}{9 - 7} = 2.4554$$

The critical F value at the .05 level is 3.2317. Thus the differences between the R^2's could be due to random chance.

Once again, the region of the country appears to be a predictor of the dependent variable but each independent variable does not act with significant difference in each region.

A discussion of the role played by each individual independent variable in the phase two, part one equations is now in order. The per capita personal income, PCPI (tables 13 and 15), of each state was always positive and always

significant in determining the level of investment in higher education human capital, as expected from past research and theory. The amount of tuition and fees paid by each student, TFPE (tables 13 through 15), as a predictor of investment was always negative and always significant; this too was as expected. In equation 22 (table 16) the college age population percentage of a state's total population, CAPT, was a significant and positive predictor. This finding is in line with past research--the higher the proportion of the college age population of a given state, the more it should be investing. The stock of higher education, SHEC, appeared in equation 20 (table 14) as positive and significant. This finding adds further support to the reasoning outlined in phase one, that a state with a larger SHEC tends to increase the investment level in higher education.

The federal aid provided to each state per college age person, FACA (tables 13 through 15), was frequently significant and always positive in most equations. The more federal aid received the greater the encouragement for state and local investment. The population density of the state, PDS (tables 13 through 15, and 22), had a significant negative effect on investment. This finding is reasonable from the standpoint that sparsely populated states must spend more money to provide the same degree of commuting accessibility to institutions. The higher the proportion of males in the college age population, SCAP, the greater the investment according to a few equations. The

finding was not statistically significant, except in model equation number 28, table 22. This single instance does reflect a known pattern of past thinking of not sending women to college as readily as men. The proportion of students remaining in the state to attend college of all the state's residents who attend college anywhere, SRSR, was significant in two out of three part one equations (numbers 23 and 28, tables 17 and 22). This measure was always positive, a finding that is congruent with the expectation that the more students who remain in the state, the greater must be the investment in higher education.

In three of the regional additive equations (numbers 20, 22, and 28), one particular region was statistically significant. In model equation number 20 (table 14), which explains investment using the free-access of the non-white population, FANW, and the per capita personal income, PCPI, it was the South, D2, which was different from the other regions. This can be interpreted as the difficulty of the region in reading the large population of non-whites; the FANW coefficient was positive.

In the two equations (numbers 22 and 28, tables 16 and 22) for predicting investment by using data for the revenues per college age person, RPCA, the dummy variables for the Northeast region, D1, were significant. This region has had a long tradition of private higher education and only recently has established and expanded public

institutions of higher learning; thus, the revenues provided per college age person from state and local government in this region vary from other regions.

As was already noted in phase one models, the future income anticipated, FIA, was negative. It was significant in equation 19 in which it appeared. The variable, revenues available for higher education per college age person, RPCA, was always positive and was significant in two out of three equations. The enrollment of students as a percent of the college age population, ENCA, ceased to be significant and was dropped when phase one equations were transformed to phase two equations, i.e. when the phase one models were re-run with additional regional, demographic and economic variables.

The final equal opportunity variable which was significant in the original phase one models, the non-white population which is within commuting distance of a free-access institution, FANW, was always positive and always significant. In fact, it appeared in the regional additive equations with the most predictive power.

Recognition should also be given to those variables which did not play major roles (significant or not) in the final equations of phase two. The percent of high school graduates per eighteen year olds in the state, HSGP, was not in evidence in the regional additive equations or regional interactive equations. The net migration rate in proportion to the college age population, MCAP, did not appear in any

final equations. In contrast, the ratio of students who migrated out-of-state to attend college as a proportion of students who were attending college anywhere, SRSR, did appear in several final equations, once at a significant level (table 17). Finally, the urbanization of the state, URBN, did not appear to affect the level of investment.

An examination was made of the residuals of the four remaining equal opportunity equations. None of the four equations display an inordinate number of "outliers." Equations 20, 22 and 28 each had one outlier, and equation 19 had zero outliers. According to Anscombe and Tukey (1965), "probably the single most important reason for calculating residuals is to look at outliers," (p. 146). In addition Kolmogorov statistics were calculated for the normality of the residuals (Lehmann, 1959). The probabilities for normality of equations 19, 22 and 28 were greater than .10 while the probability for equation 20 was .033. Thus there is some question about the normality of its residuals, hence prediction efforts should be limited to equations 19, 22 and 28.

To alleviate the concern that the R^2's of equations 19 and 28 are larger than that of the other two equations, by virtue of employing more independent variables, it is possible to use a technique developed by Aitkins (1974) to look for significant subsets of variables which are no more than 5 percent smaller than the R^2's of the complete equations, i.e. to try to find equations with equal or better

predictive power with fewer variables. The basic computational formula is

$$R_o^2 \text{ (the critical value)} = 1 - (1 - R_x^2)(1 + d^{\alpha}_{n,\,p}),$$

where

$$d_{n,\,p} = pF^{\alpha}_{p,\,n-p-1}/(n - p - 1),$$

R_x^2 is the full model R^2, α is the desired significance level (.05), p is the number of independent variables, n is the number of cases in the sample (50), n - p - 1 is the degree of freedom and $pF^{\alpha}_{p,\,n-p-1}$ is the F value for the desired significance level with certain degrees of freedom.

For equation 19

$$R_{19}^2 = .73567$$

$$R_o^2 = 1 - (.26433)(1 + .37) = .63787$$

$$d_{n,\,p} = 7F^{.05}_{7,\,50-7-1}/(50 - 7 - 1)$$

where $d_{n,\,p} = 7\ (2.24)\ /\ 44 = .37.$

Two subsets of significant variables which exceeded this critical value were FACA, TFPE, PCPI, PDS, FANW, a_{19} with an R^2 of .68318 and FACA, TFPE, PCPI, PDS, FANW, FIA, a_{19} with an R^2 of .72138. Since the smaller subset was contained in the larger subset and it still exceeded the critical value it was the best significant subset. It is a five variable equation. When compared with five variable versions of the other two equations (number 22, R^2 = .67340, number 20, R^2 = .63915) it still accounted for a larger variance in the dependent variable.

For equation 22

$$R_{22}^2 = .73982$$

$$R_o^2 = 1 - (.26018)(1 + .37) = .64356$$

$$d_{n,\,p} = 7F^{.05}_{n,\,50-7-1} / (50 - 7 - 1)$$

where $d_{n,\,p} = 7\,(2.24) / 44 = .37.$

Two subsets of significant variables which exceeded this critical value were RPCA, D1, FACA, FANW, SCAP, a_{22} with an R^2 of .68871 and RPCA, D1, FACA, FANW, SCAP, SRSR, a_{19} with an R^2 of .71546. Since the smaller subset was contained within the larger subset and it still exceeded the critical value, it was the best significant subset. It is also a five variable equation. When compared with five variable versions of the other two equations, number 22 where R^2 = .67340 and number 20 where R^2 = .63915, it still accounted for a larger variance in the dependent variable.

In summary, it can be said that those equations which included the proportion of the total non-white population which was within commuting distance of free-access institutions, FANW, generated the strongest predictions for level of human capital investment in higher education, especially when it appeared in the same equation with the revenues per college age person, RPCA. Generally, investment exhibited a dependence upon economic conditions such as the federal aid per college age person, FACA, the per capita personal income, PCPI, the future income anticipated, FIA, or the previous investment in the stock of higher education capital, SHEC. In addition, a demographic variable was also important to these equations--the population density of the state, PDS, or

the proportion of males in the college age population, SCAP. Finally, an indicator of state effort or lack thereof, the tuition and fees paid per enrollee, TFPE, was also important.

Another top predictive equation included the state and local revenues which were available per college age person as the only equal opportunity variable. In this particular equation demographic variables were important--the college age proportion of the total state population, CAPT, and the out-of-state migration rate per total college attenders from that state, SRSR. The Northeast part of the country, D1, showed such differences in revenues that a distinction must be made in the equation.

As was noted earlier, the South was similarly distinctive in policy actions which affected the proportion of the non-white population within commuting distance of a free-access college or university.

SUMMARY AND CONCLUSIONS

This study attempted to develop one or more equal opportunity concern models which could be used in explaining the relationships between state economic, demographic and policy action characteristics and the level of investment which had been made for higher education human capital for fiscal year 1968-69. An understanding of the

relative importance of economic and demographic conditions versus policy actions will provide decision makers with an increased ability to forecast the outcomes of various policy alternatives, some of which have certain simultaneous implications for increasing access to higher education as well as for increasing levels of investment.

In contrast to recent national planning models (Carlson, Weathersby, & Farmer, 1974; Huckfeldt, Weathersby, & Kirschling), the models derived from this study treat states as individual decision making units and take into consideration regional variations of the various model components. Furthermore, the models from this study permit calculation of the effects of changes in the level of tuition and fees, plus they give simultaneous consideration for the effort of future income anticipated and past investment made in the capital of higher education. Finally, the models provide for the interaction of federal aid and state and local investment. The results reported in tables 13, 14, and 22 indicate that one measure of state and local efforts to provide potential students access to institutions of higher education (FANW--the proportion of non-white population which is within commuting distance of a free-access college or university) was a very significant (at .001 and .002 levels) determinant of investment in higher education human capital. This measure was as significant (or slightly less so) than indicators of economic ability, such as the per capita personal income and federal aid per college age person. In comparison to

demographic conditions, FANW was equally significant or more so than population density, college age population as a proportion of the total state population (an indicator of burden), and proportion of males in the college age population.

The other equal opportunity concern variable which proved very significant in predicting investment in higher education human capital (at a level of less than .001 according to data in tables 16 and 22) is a measure of efforts, the revenues per person of college age (RPCA). This variable was more significant than any of the economic ability measures or state demographic characteristics.

Conclusions about the findings from this study and their importance for decision makers are offered after an assessment of their relevance to forecasting is made. As a test of the forecasting capabilities of the "best" equal opportunity model, predictions were made for four states (Vermont, Florida, Illinois, and California) chosen to represent the four different regions of the country. Data for fiscal years 1970-71 and 1971-72, several years later than the 1968-69 baseline data, were used in this assessment. Employing the "best" model equation, number 28, small errors of prediction were evidenced with regard to three of the states, Vermont, Illinois, and California. The prediction error for Vermont for 1970-71 was 4.5 percent, while that for 1971-72 was 8.1

percent, i.e. model 28 predicted less than actual investment. For Illinois the prediction error for both 1970-71 and 1971-72 was 9.8 percent over actual investment. For California the prediction error for 1970-71 was 10.0 percent and for 1971-72 it was 6.7 percent, again prediction being less than actual investment. In contrast, predictions for Florida was above actual levels of investment for both years. For 1970-71 the prediction error was 34.3 percent, while that for 1971-72 was 37.7 percent.

Model equation number 28 provides for an estimate of the level of investment in higher education as explained by three demographic variables (the percent of males in the college age population, SCAP, the proportion of students remaining in state to attend college, SRSR, and the population density of the state, PDS), one economic variable (the federal aid per college age person, FACA), and two equal opportunity variables (the revenues per college age person, RPCA, and the proportion of the non-white population within commuting distance of a free-access college or university, FANW). Only the equal opportunity variables can be altered by the actions of state policy makers. A comparison by Willingham (1970) for the fall of 1968 showed that "Florida ranks among the top five states in the country with respect to the accessibility of higher education (p.66)," ranking fourth for non-white accessibility. With this high level of accessibility achievement already attained it would be logical to conclude that the actions of policy makers which

determine the revenues per college age population seem to have diminished support in the time span from fiscal year 1968-69 to fiscal year 1970-71 or 1971-72. This "slow down" in revenues appropriated may be seen as culminating in the "non growth" funding by the 1975 Florida Legislature.

An alternative explanation considered was that the tremendous increase in population that Florida has experienced in the last decade might account for the inability to keep up with the level of revenues per college age person; however, a comparison of the increases in the college age populations for Vermont, Illinois, California, and Florida showed that Florida has experienced a smaller rate of increase in this variable than the other three states. Clearly, revenues for higher education were on the decline in Florida, not only ending a period of growth, but perhaps actually reducing educational opportunity.

RECOMMENDATIONS

After taking into consideration the findings and limitations of this study the investigator makes the following recommendations for future research:

1. Further tests of these equal opportunity concern models need to be done over an extended period of time. Because of the new data base of the National Commission on the Financing of Postsecondary Education (Carlson et al., 1973) the time lag between data collection and public

availability may be decreased. Time series data and cross-sectional data can be combined and compared according to procedures suggested by Morss, Fredland & Hymans (1967).

2. The equal opportunity concern models need to incorporate and be tested using data on the enrollment, finances, and accessibilities of different types of institutions, for states do employ radically different mixes of kinds of instruction. It was the investigator's intention to do that in this study but even using data as old as 1968-69 did not permit complete data by institutional type. Recent work by Solomon and Watchtel (1975) demonstrated rather clearly the differences in individual incomes that result from attending different types of institutions.

3. The equal opportunity concern models might be further improved by incorporating a quantitative measure of trends in state and local spending for services other than higher education. References to the increased competition between higher education and other state programs are legion (Carnegie Commission, 1971; Chambers, 1970, 1975).

4. Consideration should be given to the possibility of examining the entire spectrum of postsecondary education institutions through these investment prediction models. As of January 1, 1975, forty-five states have expressed the need to view all postsecondary institutions in many areas of planning by establishing postsecondary education ("1202") planning commissions (Breve, 1975).

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Footnotes

[1]A description of the derivation of all variables used in this paper is available from the author.

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TABLE I

DEGREES OF PARTICIPATION OF INDEPENDENT VARIABLES
IN MODEL REGRESSION EQUATIONS

	PCPI	FIA	GINI	TPPE	SHEC	CAPT	FATP	FANW	ENCA	RPCA	NWCA	SCAP	HSGP	FACA	MCAP	SRSR	URBN	PDS	D1	D2	D3
Equation 1	x	x*	x	x*	x	x															
Equation 2	x	x*		x*	x	x	x														
Equation 3	x	x*		x*	x	x		x*													
Equation 4	x	x*		x*	x	x			x*												
Equation 5	x	x		x*	x	x				x*											
Equation 6		x*	x	x*	x	x	x														
Equation 7		x*	x	x*	x*	x		x*													
Equation 8		x*	x	x*	x*	x			x												
Equation 9		x	x	x*	x*	x				x*											
Equation 10	x*	x*		x*	x		x				x										
Equation 11	x	x*		x*	x			x*			o										
Equation 12	x	x*		x*	x				x*		x										
Equation 13	x	x*		x*	x					x*	x										
Equation 14	x	x*	x	x*	x						o										
Equation 15		x*	x	x*	x*		x				x										
Equation 16		x*	x	x*	x*			x*			x										
Equation 17		c*	x	x*	x*				x		x										
Equation 18		x*	x	x*	x					x	x										
Equation 19	x*	x*	o	x*	o	o		x*			o	x	o	x*	o	o	o	x*	o	o	o
Equation 20	o	o		x*	x*	x		x*				o	o	x*	o	o	o	x*	o	x*	o
Equation 21	x*	o		x*	o				o		o	o	o	x*	o	o	o	x*	o	o	o
Equation 22	o	o	o	o	o	x*				x*	o	o	o	x	o	x	o	o	x*	o	o
Equation 23	x	o								x		x*	o	x	o	x*	o	o	x*	o	x
Equation 24	x*	x	o	x*	o	o		x*			o	o	o	x*	o	o	o	x*	o	o	o
Equation 25	o	o		x*		o		x*				o	o	x*	o	o	o	x	o	o	x*
Equation 26	x*	o		x*	o				o		o	o	o	x*	o	o	o	x*	o	o	o
Equation 27	o	o	o	o	o					x*	o	o	o	x*	o	o	o	o	o	o	o
Equation 28								x*		x*		x*	o	x		x		x	x		
Equation 29								x*		x*		x		x*							

o = variable was considered in the regression analysis

x = variable appeared in the resulting regression equation

* = variable was significant at the .05 level

TABLE 2

BASIC STATISTICS FOR INDIVIDUAL VARIABLES (CODEBOOK)

	Mean	Median	Standard Deviation	Kurtosis	Skewness	Range
PCPI	3201.300	3248.000	538.580	-.782	.064	2175.000
FIA	3783.630	3696.000	840.872	.176	.522	3884.000
CAPT	10.713	10.485	1.210	1.375	1.172	5.220
GINI	.357	.349	.026	-.516	.445	.114
SHEC	2.368	2.312	.737	1.045	.671	3.617
FATP	39.780	40.833	17.601	.543	-.274	87.000
FANW	35.690	41.050	27.333	-1.157	-.019	90.000
SCAP	51.435	50.965	3.694	8.615	2.484	21.830
NWCA	.113	.092	.095	2.751	1.541	.466
HSGP	.795	.787	.080	-1.050	.131	.273
FACA	65.722	58.410	28.997	4.514	1.591	163.440
MCAP	.034	.026	.034	4.823	2.173	.153
URBN	52.426	53.250	26.595	-.912	-.316	97.200
PDS	135.213	69.820	199.663	5.142	2.399	891.180
D1	.180	.110	.388	.775	1.666	1.000
D2	.320	.235	.471	-1.404	.772	1.000
D3	.240	.158	.431	-.518	1.218	1.000
ISL	27.117	27.288	7.958	-.053	.591	33.466
RPCA	5296.500	5438.000	1281.441	.833	.461	6745.000
TFPE	526.780	518.000	226.610	3.623	1.563	1211.000
ENCA	.788	.825	.115	.096	-.963	.440
SRSR	.294	.296	.081	-.100	-.032	.407

TABLE 3

SIMPLE PEARSON CORRELATION COEFFICIENTS
BETWEEN VARIABLES

	PCPI	FIA	CAPT	GINI	SHEC	FATP	FANW	SCAP	NWCA	HSGP
FIA	.437*									
CAPT	-.324*	-.114								
GINI	-.654*	-.106	.451*							
SHEC	.741*	.065	-.069	-.482*						
FATP	-.007	.313*	.152	.298*	.003					
FANW	.037	.462*	-.089	.237	-.190	.703*				
SCAP	-.074	-.248	.726*	.308*	.184	.013	-.288*			
NWCA	-.187	.250	.610*	.528*	-.207	.341*	.174	.351*		
HSGP	.165	-.250	-.451*	-.399*	.165	-.368*	-.401*	-.106	-.472*	
FACA	-.055	-.456*	-.177	-.084	.210	-.071	-.301*	.014	-.225	
MCAP	.252	.049	-.139	-.357*	.356*	-.022	-.084	-.164	-.307*	.123
URBN	.578*	.639	-.245	-.359*	.223	.118	.347*	-.395*	.136	-.190
PDS	.513*	.619*	-.282	-.333*	.161	.218	.299*	-.208	-.013	-.039
D1	.342*	.321*	-.297*	-.442*	.106	.011	-.036	-.163	-.262	.211
D2	-.532*	.189	.426*	.703*	-.467*	.370*	.363*	.066	.533*	-.599*
D3	.134	-.122	-.403*	-.234	-.069	-.301*	-.058	-.254	-.276	.323*
ISL	.257	-.353*	-.031	-.151	.463*	.043	-.042	.222	-.117	.166
RPCA	.636*	-.132	-.414*	-.465*	.701*	-.171	-.245	.045	-.415*	.445*
TFTE	.140	.237	-.225	-.406*	-.071	-.045	.005	-.301*	-.280	.124
ENCA	-.343*	-.082	-.071	.287*	-.390*	.074	.280	-.326*	.078	-.276
SRSR	.089	-.303*	-.544*	-.394*	.188	-.101	-.145	-.390*	-.641	.415*

* significant from zero at .05 level

TABLE 3--Continued

	FACA	MCAP	URBN	POS	D1	D2	D3	ISL	RPCA	TFPE	ENCA
FIA											
CAPT											
GINI											
SHEC											
FATP											
FANN											
SCAP											
NNCA											
HSGP											
FACA											
MCAP	.095										
URBN	-.291*	.162									
POS	-.319*	.367*	.589*								
D1	-.117	.392*	.213	.653*							
D2	-.420*	-.306*	-.090	-.113	-.321*						
D3	.114	-.102	-.054	-.137	-.263	-.385*					
ISL	.540*	-.033	-.060	-.350*	-.392*	.391*	.102				
RPCA	.519*	.171	.062	.061	.038	-.664*	.173	.653*			
TFPE	-.118	.322*	-.001	.318*	.691*	-.151	.055	-.449*	-.168		
ENCA	.113	-.230	.167	-.321*	-.429*	.192	.247	.137	-.201	-.333*	
SRSR	.572*	.294*	.045	-.070	.053	-.544*	.325*	.380*	.425*	.042	.326*

* significant from zero at .05 level

TABLE 4

MULTIVARIATE REGRESSION RESULTS FOR
BASIC EQUAL OPPORTUNITY MODELS
PHASE ONE

Model (1)	PCPI	FIA	GINI	TFPE	SHEC	CAPT	a_1	R	R^2
Coefficient	.0040	-.0038*	-15.1800	-.0142*	2.503	-.2753	38.5100	.71475*	.51087
Significance	.2690	.0070	.7820	.0030	.223	.7400	.1290	.00000	
Model (2)	PCPI	FIA	FATP	TFPE	SHEC	CAPT	a_2	R	R^2
Coefficient	.5517	-.0048*	.0900	-.0131*	2.028	-.4618	31.2200*	.73678*	.54284
Significance	.0870	.0010	.0860	.0010	.310	.5500	.0100	.00000	
Model (3)	PCPI	FIA	FANW	TFPE	SHEC	CAPT	a_3	R	R^2
Coefficient	.0047	-.0052*	.0736*	-.0123*	3.087	-.1839	30.2700*	.74540*	.55561
Significance	.1330	.0000	.0420	.0030	.120	.8090	.0120	.00000	
Model (4)	PCPI	FIA	ENCA	TFPE	SHEC	CAPT	a_4	R	R^2
Coefficient	.0050	-.0041*	16.9000*	-.0102*	3.418	N.E.	10.5900	.74214*	.55077
Significance	.0800	.0010	.0460	.0160	.082		.2920	.00000	
Model (5)	PCPI	FIA	RPCA	TFPE	SHEC	CAPT	a_5	R	R^2
Coefficient	.0007	-.0020	.0038*	-.0094*	N.E.	1.0140	6.3440	.77706*	.60382
Significance	.7930	.1210	.0010	.0170		.1780	.5960	.00000	

*significant from zero at .05 level
N.E.= variable would not enter equation because F statistic was too small

TABLE 5

MULTIVARIATE REGRESSION RESULTS FOR MODELS
WHICH EMPLOY GINI FOR PCPI: SERIES
ONE VARIATIONS, PHASE ONE

Model (6)	GINI	FIA	FATP	TFPE	SHEC	CAPT	a_6	R	R^2
Coefficient	-74.890	-.0035*	.1009	-.0155*	3.601*	-.4946	68.150*	.73099*	.53435
Significance	.143	.0020	.0690	.0010	.015	.5320	.001	.00000	
Model (7)	GINI	FIA	FANW	TFPE	SHEC	CAPT	a_7	R	R^2
Coefficient	-73.120	-.0042*	.0867*	-.0146*	4.369*	-.0949	64.410*	.74535*	.55554
Significance	.134	.0010	.0210	.0010	.003	.9040	.001	.00000	
Model (8)	GINI	FIA	ENCA	TFPE	SHEC	CAPT	a_8	R	R^2
Coefficient	-42.800	.0029*	15.7200	-.0116*	5.185*	-.1879	36.760	.72930*	.53189
Significance	.371	.0070	.0790	.0190	.001	.8160	.096	.00000	
Model (9)	GINI	FIA	RPCA	TFPE	SHEC	CAPT	a_9	R	R^2
Coefficient	-26.870	-.0018	.0038*	-.0105*	N.E.	1.1240	17.020	.77919*	.60714
Significance	.509	.0590	.0000	.0150		.1360	.405	.00000	

*significant from zero at .05 level
N.E.= variable would not enter equation because F statistic was too small

TABLE 6

MULTIVARIATE REGRESSION RESULTS FOR MODELS
WHICH EMPLOY NWCA FOR CAPT: SERIES
TWO VARIATIONS,
PHASE ONE

Model (10)	PCPI	FIA	FATP	TFPE	SHEC	NWCA	a_{10}	R	R^2
Coefficient	.0060*	-.0047*	.0931	-.0135*	1.6650	-5.304	25.860*	.73603*	.54174
Significance	.0500	.0020	.0820	.0020	.3880	.614	.000	.00000	
Model (11)	PCPI	FIA	FANW	TFPE	SHEC	NWCA	a_{11}	R	R^2
Coefficient	.0050	-.0052*	.0744*	-.0122*	2.9610	N.E.	27.800*	.74499*	.55500
Significance	.0790	.0000	.0360	.0020	.1180		.000	.00000	
Model (12)	PCPI	FIA	ENCA	TFPE	SHEC	NWCA	a_{12}	R	R^2
Coefficient	.0051	-.0042*	17.2240*	-.0098*	3.4420	2.306	9.845	.74250*	.55130
Significance	.0820	.0030	.0480	.0340	.0840	.823	.357	.00000	
Model (13)	PCPI	FIA	RPCA	TFPE	SHEC	NWCA	a_{13}	R	R^2
Coefficient	N.E.	-.0024*	.0035*	-.0088*	.9961	10.970	18.720*	.77535*	.60117
Significance		.0190	.0010	.0310	.5070	.285	.003	.00000	
Model (14)	PCPI	FIA	GINI	TFPE	SHEC	NWCA	a_{14}	R	R^2
Coefficient	.0043	-.0038*	-20.2700	-.0142*	2.3110	N.E.	37.130	.71386*	.50960
Significance	.2240	.0060	.6970	.0030	.2360		.133	.00000	

*significant from zero at .05 level
N.E. = variable would not enter equation because F statistic was too small

TABLE 7

MULTIVARIATE REGRESSION RESULTS FOR MODELS
WHICH EMPLOY GINI FOR PCPI AND NWCA
FOR CAPT: SERIES THREE
VARIATIONS, PHASE ONE

Model (15)	GINI	FIA	FATP	TFPE	SHEC	NWCA	a_{15}	R	R^2
Coefficient	-85.320	-.0034*	.1011	-.0157*	3.4320*	-1.417	66.820*	.72816*	.53021
Significance	.094	.0050	.0710	.0010	.0190	.901	.002	.00000	
Model (16)	**GINI**	**FIA**	**FANW**	**TFPE**	**SHEC**	**NWCA**	a_{16}	**R**	R^2
Coefficient	-86.340	-.0045*	.0903*	-.0142*	4.3540*	5.347	68.190*	.74687*	.55781
Significance	.076	.0010	.0160	.0020	.0020	.630	.001	.00000	
Model (17)	**GINI**	**FIA**	**ENCA**	**TFPE**	**SHEC**	**NWCA**	a_{17}	**R**	R^2
Coefficient	-54.650	-.0030*	16.5400	-.0112*	5.1850*	3.968	38.190	.72982*	.53263
Significance	.255	.0090	.0620	.0260	.0010	.727	.093	.00000	
Model (18)	**GINI**	**FIA**	**RPCA**	**TFPE**	**SHEC**	**NWCA**	a_{18}	**R**	R^2
Coefficient	-28.280	-.0025*	.0034*	.0099*	.7078	13.350	30.780	.77776*	.60491
Significance	.527	.0170	.0010	.0270	.6530	.226	.128	.00000	

*significant from zero at .05 level

TABLE 8

MULTIVARIATE REGRESSION RESULTS FOR ORIGINAL McMAHON MODEL AND ITS ONE VARIATION WHICH EMPLOYS NWCA FOR CAPT
PHASE ONE

Model (1)	PCPI	FIA	GINI	TFPE	SHEC	CAPT	a_1	R	R^2
Coefficient	.0040	-.0038*	-15.180	-.0142*	2.503	-.2753	38.510	.71475*	.51087
Significance	.2690	.0070	.7820	.0030	.223	.7400	.129	.00000	
Model (14)	PCPI	FIA	GINI	TFPE	SHEC	NWCA	a_{14}	R	R^2
Coefficient	.0043	-.0038*	-20.270	-.0142*	2.311	N.E.	37.130	.71386*	.50960
Significance	.2240	.0060	.697	.0030	.236		.133	.00000	

*significant from zero at .05 level
N.E.= variable would not enter equation because F statistic was too small

TABLE 9

MULTIVARIATE REGRESSION RESULTS FOR FATP MODEL
EQUATION AND ITS VARIATIONS
PHASE ONE

Model (2)	PCPI	FIA	FATP	TFPE	SHEC	CAPT	a_2	R	R^2
Coefficient	.5517	-.0048*	.0900	-.0131*	2.028	-.4618	31.220*	.73678*	.54284
Significance	.0870	.0010	.0680	.0010	.310	.5500	.010	.00000	
Model (10)	PCPI	FIA	FATP	TFPE	SHEC	NWCA	a_{10}	R	R^2
Coefficient	.0060*	-.0047*	.0931	-.0135*	1.665	-5.3040	25.860*	.73603*	.54174
Significance	.0500	.0020	.0820	.0020	.388	.6140	.000	.00000	
Model (6)	GINI	FIA	FATP	TFPE	SHEC	CAPT	a_6	R	R^2
Coefficient	-74.8900	-.0035*	.1009	-.0155*	3.601*	-.4946	68.150*	.73099*	.53435
Significance	.143	.0020	.0690	.0010	.015	.5320	.001	.00000	
Model (15)	GINI	FIA	FATP	TFPE	SHEC	NWCA	a_{15}	R	R^2
Coefficient	-85.3200	-.0034*	.1011	-.0157*	3.432*	-1.4170	66.820*	.72816*	.53021
Significance	.0940	.0050	.0710	.0010	.019	.9010	.002	.00000	

*significant from zero at .05 level

TABLE 10

MULTIVARIATE REGRESSION RESULTS FOR FANW MODEL
EQUATION AND ITS VARIATIONS
PHASE ONE

Model (3)	PCPI	FIA	FANW	TFPE	SHEC	CAPT	a_3	R	R^2
Coefficient	.0047	-.0052*	.0736*	-.0123*	3.087	-.1839	30.270*	.74540*	.55561
Significance	.1330	.0000	.0420	.0030	.120	.8090	.012	.00000	
Model (11)	**PCPI**	**FIA**	**FANW**	**TFPE**	**SHEC**	**NWCA**	a_{11}	**R**	R^2
Coefficient	.0050	-.0052*	.0744*	-.0122*	2.961	N.E.	27.800*	.74499*	.55500
Significance	.0790	.0000	.0360	.0020	.118		.000	.00000	
Model (7)	**GINI**	**FIA**	**FANW**	**TFPE**	**SHEC**	**CAPT**	a_7	**R**	R^2
Coefficient	-73.1200	-.0042*	.0867*	-.0146*	4.369*	-.0949	64.410*	.74535*	.55554
Significance	.1340	.0010	.0210	.0010	.003	.9040	.001	.00000	
Model (16)	**GINI**	**FIA**	**FANW**	**TFPE**	**SHEC**	**NWCA**	a_{16}	**R**	R^2
Coefficient	-86.3400	-.0045*	.0903*	-.0142*	4.354*	5.347	68.190*	.74687*	.55781
Significance	.0760	.0010	.0160	.0020	.002	.630	.001	.00000	

*significant from zero at .05 level
N.E.= variable would not enter equation because F statistic was too small

TABLE 11

MULTIVARIATE REGRESSION RESULTS FOR ENCA MODEL
EQUATION AND ITS VARIATIONS
PHASE ONE

Model (4)	PCPI	FIA	ENCA	TFPE	SHEC	CAPT	a_4	R	R^2
Coefficient	.0050	-.0041*	16.900*	-.0102*	3.418	N.E.	10.590	.74214*	.55077
Significance	.0800	.0010	.046	.0160	.082		.292	.00000	
Model (12)	PCPI	FIA	ENCA	TFPE	SHEC	NWCA	a_{12}	R	R^2
Coefficient	.0051	-.0042*	17.224*	-.0098*	3.442	2.3060	9.845	.74250*	.55130
Significance	.0820	.0030	.048	.0340	.084	.8230	.357	.00000	
Model (8)	GINI	FIA	ENCA	TFPE	SHEC	CAPT	a_8	R	R^2
Coefficient	-42.8000	-.0029*	15.720	-.0116*	5.185*	-.1879	36.760	.72930*	.53189
Significance	.3710	.0070	.079	.0190	.001	.8160	.096	.00000	
Model (17)	GINI	FIA	ENCA	TFPE	SHEC	NWCA	a_{17}	R	R^2
Coefficient	-54.6500	-.0030*	16.540	-.0112*	5.185*	3.968	38.190	.72982*	.53263
Significance	.2550	.0090	.062	.0260	.001	.727	.093	.00000	

*significant from zero at .05 level
N.E.= variable would not enter equation because F statistic was too small

TABLE 12

MULTIVARIATE REGRESSION RESULTS FOR RPCA MODEL
EQUATION AND ITS VARIATIONS
PHASE ONE

Model (5)	PCPI	FIA	RPCA	TFPE	SHEC	CAPT	a_5	R	R^2
Coefficient	.0007	-.0020	.0038*	-.0094*	N.E.	1.014	6.344	.77706*	.60382
Significance	.7930	.1210	.0010	.0170		.178	.596	.00000	
Model (13)	PCPI	FIA	RPCA	TFPE	SHEC	NWCA	a_{13}	R	R^2
Coefficient	N.E.	-.0024*	.0035*	-.0088*	.9961	10.970	18.720*	.77535*	.60117
Significance		.0190	.0010	.0310	.5070	.285	.003	.00000	
Model (9)	GINI	FIA	RPCA	TFPE	SHEC	CAPT	a_9	R	R^2
Coefficient	-26.8700	-.0018	.0038*	-.0105*	N.E.	1.124	17.020	.77919*	.60714
Significance	.5090	.0590	.0000	.0150		.136	.405	.00000	
Model (18)	GINI	FIA	RPCA	TFPE	SHEC	NWCA	a_{18}	R	R^2
Coefficient	-28.2800	-.0025*	.0034*	-.0099*	.7078	13.350	30.780	.77776*	.60491
Significance	.5270	.0170	.0010	.0270	.6530	.226	.129	.00000	

*significant from zero at .05 level
N.E.= variable would not enter equation because F statistic was too small

TABLE 13

MULTIVARIATE REGRESSION RESULTS FOR FANW MODELS, PHASE TWO,
PART I: REGIONAL ADDITIVE EFFECTS
(Phase One Equations 7 and 16)

Model (19)	FACA	TFPE	PCPI	PDS	FANW	FIA	SCAP	a_{19}	R	R^2
Coefficient	.1101*	-.0096*	.0091*	-.0140*	.0959*	-.0026*	.2873	-10.680	.85771*	.73567
Significance	.0000	.0040	.0000	.0030	.0010	.0260	.1390	.394	.00000	

* significant from zero at .05 level

TABLE 14

MULTIVARIATE REGRESSION RESULTS FOR FANW MODELS, PHASE TWO,
PART I: REGIONAL ADDITIVE EFFECTS
(Phase One Equations 3 and 11)

Model (20)	FACA	TFPE	SHEC	PDS	FANW	D2	a_{20}	R	R^2
Coefficient	.0776*	-.0116*	3.7804*	-.0138*	.0963*	-5.3878*	19.3419*	.83434*	.69613
Significance	.0080	.0010	.0010	.0020	.0020	.0070	.0000	.00000	

* significant from zero at .05 level

TABLE 15

MULTIVARIATE REGRESSION RESULTS FOR SIGNIFICANT ENCA MODELS,
PHASE TWO, PART I: REGIONAL ADDITIVE EFFECTS
(Phase One Equations 4 and 12)

Model (21)	FACA	TFPE	PCPI	PDS	a_{21}	R	R^2
Coefficient	.1119*	-.1248*	.0077*	-.0149*	3.6176	.80408*	.64654
Significance	.0000	.0000	.0000	.0020	.4850	.00000	

* significant from zero at .05 level

TABLE 16

MULTIVARIATE REGRESSION RESULTS FOR RPCA MODELS, PHASE TWO,
PART I: REGIONAL ADDITIVE EFFECTS
(Phase One Equations 9 and 13)

Model (22)	RPCA	D1	FACA	CAPT	SRSR	a_{22}	R	R^2
Coefficient	.0039*	-6.9331*	.0249	1.7677*	21.8164	-19.550	.82061*	.67340
Significance	.0000	.0010	.4530	.0260	.0850	.090	.00000	

* significant from zero at .05 level

TABLE 17

MULTIVARIATE REGRESSION RESULTS FOR RPCA MODELS, PHASE TWO,
PART I: REGIONAL ADDITIVE EFFECTS
(Phase One Equations 5 and 18)

Model (23)	RPCA	D1	FACA	SCAP	SRSR	D3	PCPI	a_{23}	R	R^2
Coefficient	.0020	-10.1752*	.0518	.4481*	17.6152*	-3.2578	.0037	-27.1215*	.83838*	.70288
Significance	.0690	.0000	.1630	.0450	.0310	.0810	.1060	.0500	.00000	

* significant from zero at .05 level

Note: for these two equations the equal opportunity variable, RPCA is not significant, nor are most of the other independent variables. Hence these two equations were dropped from further consideration.

TABLE 18

MULTIVARIATE REGRESSION RESULTS FOR SIGNIFICANT FANW EQUATIONS,
PHASE TWO, PART II: REGIONAL INTERACTIVE EFFECTS
(Phase One Equations 7 and 16)

Model (24)	FACA	TFPE	PCPI	PDS	FANW	FIA	(FACA)(D2)	a_{24}	R	R^2
Coefficient	.0930*	-.0120*	.0071*	-.0144*	.0974*	-.0022	-.0690	12.330	.85966*	.73902
Significance	.0010	.0000	.0000	.0020	.0010	.0690	.0990	.075	.00000	

* significant from zero at .05 level

TABLE 19

MULTIVARIATE REGRESSION RESULTS FOR SIGNIFICANT FANW EQUATIONS,
PHASE TWO, PART II: REGIONAL INTERACTIVE EFFECTS
(Phase One Equations 3 and 11)

Model (25)	FACA	TFPE	(FACA)(D2)	FANW	(PDS)(D1)	D3	PDS	a_{25}	R	R^2
Coefficient	.104*	-.013*	-.2324*	.102*	-.0303*	-4.762*	.016	28.522*	.85372*	.72884
Significance	.0000	.000	.0000	.001	.0030	.011	.118	.000	.00000	

* significant from zero at .05 level

TABLE 20

MULTIVARIATE REGRESSION RESULTS FOR SIGNIFICANT ENCA EQUATIONS,
PHASE TWO, PART II: REGIONAL INTERACTIVE EFFECTS
(Phase One Equations 4 and 12)

Model (26)	FACA	TFPE	PCPI	PDS	a_{26}	R	R^2
Coefficient	.1119*	-.1248*	.0077*	-.0149*	3.6176	.80408*	.64654
Significance	.0000	.0000	.0000	.0020	.4850	.00000	

* significant from zero at .05 level

Note: there is no difference whatsoever between regional interactive effects and regional additive effects for these equations. Thus no partial F test of R^2 differences are necessary.

TABLE 21

MULTIVARIATE REGRESSION RESULTS FOR SIGNIFICANT RPCA EQUATIONS,
PHASE TWO, PART II: REGIONAL INTERACTIVE EFFECTS
(Phase One Equations 9 and 13)

Model (27)	RPCA	(RPCA)(D1)	FACA	(HSGP)(D3)	(FACA)(D2)	(RPCA)(D3)	a_{27}	R	R^2
Coefficient	.002*	-.0021*	.056*	-29.8125*	-.1194*	.3537	15.903*	.85088*	.72399
Significance	.003	.0000	.040	.0470	.0070	.1050	.001	.00000	

* significant from zero at .05 level

TABLE 22

MULTIVARIATE REGRESSION RESULTS FOR COMBINATION MODEL
PHASE TWO, PART ONE: REGIONAL
ADDITIVE EFFECTS

Model 28	RPCA	D1	FACA	FANW	SCAP	SRSR	PDS	a_{28}	R	R^2
Coefficient	.0037*	-4.0183	.0241	.0917*	.6250*	22.4015	-.0099	-34.0651*	.86013*	.73982
Significance	.0000	.0880	.4500	.0020	.0050	.0520	.0540	.0090	.00000	

* significant from zero at .05 level

TABLE 23

MULTIVARIATE REGRESSION RESULTS FOR COMBINATION MODEL
PHASE TWO, PART TWO: REGIONAL
INTERACTIVE EFFECTS

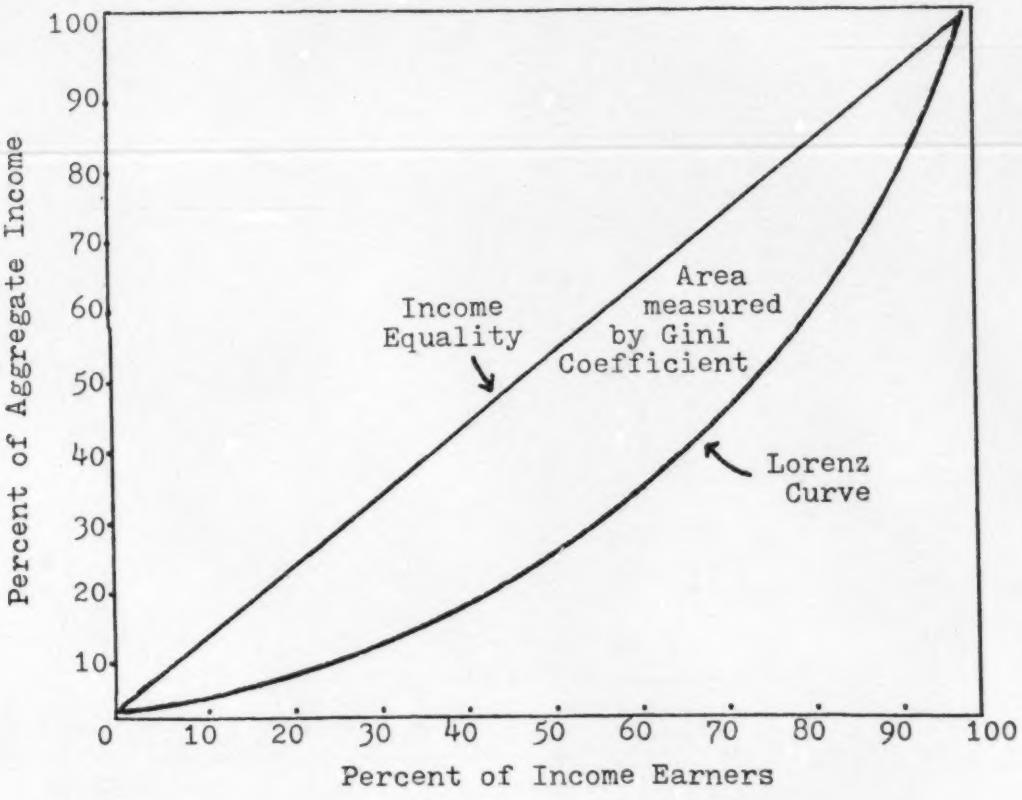
Model 29	RPCA	(RPCA)(D1)	FACA	FANW	SCAP	(FACA)(D2)	(SCAP)(D2)	a_{29}	R	R^2
Coefficient	.0028*	-.0021*	.0630*	.0837*	.7039	-.1455*	-.0082*	2.9504	.87651*	.76827
Significance	.0000	.0000	.0150	.0020	.3220	.0010	.0260	.7850	.00000	

* significant from zero at .05 level

APPENDIX A

THE LORENZ CURVE OF INCOME INEQUALITY

Income distributions may be observed by means of a Lorenz curve which shows the cumulative proportions of aggregate income accrueing to cumulative proportions of the population ranging in order from the lowest to the highest income earners. Perfect equality is represented on a Lorenz chart by a diagonal straight line rising from the lower left hand corner to the upper right hand corner. The greater the degree of convexity of the plotted Lorenz curve, the greater the degree of inequality in the political system. The total area which falls between the Lorenz curve, representing the actual income distribution, and the straight diagonal line, representing perfect income equality, expresses the degree of income inequality. This area is measured by a Gini coefficient or Gini index, which ranges from +1.00 to 0.00.



Sources and Calculation of Values for Variables
Used in the Impact of A Taste for Equal Opportunity
by Charles E. Feasley
Given at AREA 1977 Convention

Following are the sources of data for the variables and the procedures used in the calculation of the values used in this study:

1. Investment by state and local governments in higher education (ISL) was the dependent variable under investigation;

Source: The total revenues from state and local governments for educational and general expenses, other sponsored programs, and student aid grants are taken from USOE, Financial Statistics of Institutions of Higher Education: Current Funds Revenues and Expenditures, 1968-69, pp. 17-46. These revenues were divided by the total resident population as found in U.S. Department of Commerce, Bureau of the Census, Current Population Reports Series P-25, no. 519.

2. Per capita personal income before taxes for each state, 1968 (PCPI);

Source: U.S. Department of Commerce, Office of Business Economics, Survey of Current Business 49 (August 1969), p. 15.

3. Real future income added per student (annual income differentials between high school degrees and bachelor degrees as of 1968) (FIA);

Source: An estimate of the future income anticipated in each state in 1968 was derived by taking 1970 state estimates from U.S. Department of Commerce, Bureau of the Census, U.S. Census of the Population: 1970, vol. 1, Characteristics of the Population, pts. 2-52, table 197 and interpolating according to the ratio of the income differential expected in

the U.S. for 1968. The numerator of the ratio was found in U.S. Department of Commerce, Bureau of the Census, Current Population Reports P-60, no. 74, p. 2. The denominator was found in U.S. Census Bureau, 1970 Census, pt. 1, sec. 2, U.S. Summary, table 249.

4. College age population (18-24 years old) as a percent of the total population in each state (CAPT);

Source: This variable was determined by taking the 1965 state population figures for the 18-24 year age group from U.S. Department of Commerce, Bureau of the Census, Current Population Reports P-25, no. 375 (1967), pp. 43-49, and interpolating the desired age group (18-24) for July 1, 1968 with the help of state total resident populations from U.S. Department of Commerce, Bureau of the Census, Current Population Reports P-25, no. 437 (1970), p. 7. The particular estimates of the total resident populations of states which were used assumed that (a) migration rates continued in the range observed in 1955-1960 and 1960-65 and (b) the national fertility rates declined from 1960 levels. The stability of the migration rates were verified in U.S. Department of Commerce, Bureau of the Census, Current Population Reports P-20, no. 273 (Mobility of the Population of the U.S., 1970-1974)(1974). The decline of the national fertility rate was verified in U.S. Census Bureau, Current Population Reports 519 (1974).

5. Price of tuition and fees per full-time enrollee (TFPE);

Source: A TFPE was determined by taking the total amount of money paid for tuition and fees in each state and dividing by full-time equivalent enrollment. Tuition and fees were found in U.S. Department of Health, Education and Welfare, Office of Education, Financial Statistics of

Institutions of Higher Education: Current Funds Revenues and Expenditures, 1968-69 (Washington, D.C.: U.S. Government Printing Office, 1970), pp. 17-46 (hereafter cited as USOE, Financial Statistics, 1968-69); full-time equivalent enrollment was found in USOE, Opening Fall Enrollment in Institutions of Higher Education, Fall, 1968.

6. Estimate of the stock of higher education capital per person of college age[1] (SHEC). The following steps were used to calculate SHEC:

(a) Determined the number of persons 14 years or older who had completed 1-3 years of college, then multiplied it by an average of 2 years;

(b) Determined the number of persons 14 years or older who had completed at least 4 years of college, then multiplied this by four years, (U.S. Census Bureau, 1970 Census, pts. 2-52, table 148). The proportion of the U.S. total resident population which was 14 years or older in 1968 versus 1970 was derived for use from U.S. Census Bureau, CPR 519 (1974);

(c) Added together (a) and (b);

(d) Derived an average annual resource cost per student from the following three variables: (1) foregone earnings--25 earning weeks times weekly average earnings of all manufacturing workers,[2] which were adjusted for the rate of unemployment [Source: Department of Labor, Bureau of Labor Statistics, Employment and Earnings 15 (August 1968)]. Average earnings foregone times the enrollment for each state equaled the total foregone

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[1]The conceptualization and original estimation method for a stock of higher education capital was reported in Theodore Schultz, Investment in Human Capital (New York: The Free Press, 1971), p. 85. McMahon alters the approach with the inclusion of depreciation costs (Walter McMahon, Investment in Higher Education (Lexington, Mass.: Lexington Books, 1974), p. 152).

[2]The figure of 25 weeks was supposed to represent the number of weeks of average manufacturing wage which was equal to 40 weeks of employment by a college student. Schultz, Investment, p. 85.

earnings; enrollment used was found in USOE, Opening Fall Enrollment in Institutions of Higher Education, Fall 1968); (2) expenditures for books and other private expenditures such as commuting were estimated as 10 percent of foregone earnings; (3) the total institutional cost of colleges and universities was estimated as the sum of implicit interest and depreciation charges, which were calculated as 8 percent of the value of property (as found in USOE, Financial Statistics of Institutions of Higher Education: Current Funds Revenues and Expenditures; Physical Assets, 1967-68)[1] plus current income used for instruction (as found in USOE, Financial Statistics of Institutions of Higher Education: Current Funds Revenues and Expenditures, 1968-69), including revenue from tuition and fees, governmental appropriations, endowment income, private gifts and grants, income from organized activities related to instructional departments, and fees from other miscellaneous activities. The foregone earnings, summed and then divided by state enrollments as found in USOE, Opening Fall Enrollments in Institutions of Higher Education, Fall 1968 giving the average annual resource cost per student.

(e) Multiplied the total number of college years completed, (c), times the average annual resource cost per student in higher education, (d), to calculate the estimate of the higher education capital stock; the total capital stock was then divided by the actual college age population of each state, which was estimated according to the procedure stated in no. 4 page 2;

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[1](Washington, D.C.: U.S. Government Printing Office, 1969), p. 137.

7. The proportion of a state's population within commuting distance of free-access colleges and universities (FATP);[1]

Source: Warren Willingham, Free-Access Higher Education.

8. The proportion of a state's non-white population within commuting distance of free-access colleges or universities (FANW);[2]

Source: Warren Willingham, Free-Access Higher Education.

9. The full-time equivalent enrollment as a percent of the college age population, persons 18-24 years in age (ENCA);

Source: Full-time equivalent enrollment was derived from data contained in U.S. Department of Health, Education and Welfare, Office of Education, Opening Fall Enrollment in Institutions of Higher Education, Fall 1968 (Washington, D.C.: U.S. Government Printing Office, 1969). It was divided by the college age population which was determined by taking the 1965 state population for the 18-24 year age group from U.S. Census Bureau, CPR 375, and interpolating on the state total resident population for July 1, 1968 as found in the U.S. Census Bureau, CPR 437.

10. The revenues of state and local governments per person of college age (RPCA);

Source: Revenues were obtained from the U.S. Department of Commerce, Bureau of the Census, Government Finances in 1968-69 (Washington, D.C.: U.S. Government Printing Office, 1972), pp. 31-33, and were divided by the actual college age populations of each state which was computed as described above in number 9.

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[1]Willingham made his calculations using 1960 census data which he extracted from two sources, U.S. Department of Commerce, Bureau of the Census, County and City Data Book 1967 (Washington, D.C.: U.S. Government Printing Office, 1967); Idem, Statistical Abstract of the U.S., 1968 (Washington, D.C.: U.S. Government Printing Office, 1968).

[2]Ibid.

11. Gini coefficient of family income inequality (GINI);

Source: Individual state Gini coefficients (indices of income concentration) which are employed in the study were for the year 1969 and were taken from U.S. Census Bureau, 1970 Census, pts. 2-52, table 200 (see appendix A of this study for a more complete explanation of the calculation of the Gini coefficient).

12. Non-white college age population as a percent of the total college age population (NWCA);

Source: Estimates were derived by multiplying percentages of non-white college age population for the year 1970 as found in U.S. Census Bureau, 1970 Census, PC(1)-B, pts. 2-52, table 19, by the ratio of the percent of non-white U.S. college age population for 1968 to the percent of non-white U.S. college age population for 1970. Both these figures for the U.S. population were taken from U.S. Census Bureau, CPR 519.

13. Sex distribution of college age population, the percent of males 18-24 years of age (SCAP);

Source: Base 1965 state figures were taken from U.S. Census Bureau, CPR 375. Extrapolations of the desired age group by sex were taken from United States data from U.S. Census Bureau, CPR 519.

14. High school graduates as a percent of the 18 year olds in each state (HSGP);

Source: The number of higher school graduates in each state for 1968 was taken from U.S. Department of Health, Education, and Welfare, Office of Education, Digest of Educational Statistics, 1969 (Washington,D.C.: U.S. Government Printing Office, 1969), p. 50. This figure was then divided by the number of 18 year olds in each state which was estimated by taking the 1970 count of 18 year olds as found in U.S. Census Bureau, 1970 Census,

PC(1)-B, table 146, and multiplying by the ratio of 18 year olds in the U.S. in 1968 over the ratio of 18 year olds in the U.S. in 1970, with both U.S. estimates coming from U.S. Census Bureau CPR 519.

15. Federal aid in proportion to the college age population (FACA);

Source: USOE, Financial Statistics of Institutions of Higher Education: Current Funds Revenues and Expenditures, 1968-69, gives the amounts of federal aid, which was divided by the actual college age population of each state, number 9 above.

16. Net migration rate of college students in proportion to the college age population (MCAP);

Source: Migration data were taken from U.S. Department of Health, Education, and Welfare, Office of Education, Residence and Migration of College Students Fall 1968, Analytical Report (Washington, D.C.: U.S. Government Printing Office, 1970). These quantities were divided by the college age populations of the states, number 9 above.

17. The percent of students remaining in the state to attend college of the total number of state residents enrolling in college anywhere (SRSR);

Source: These ratios were taken from USOE, Residence and Migration of College Students Fall 1968, Analytical Report, p. 22.

18. Urbanization--percent of the state's population in standard metropolitan statistical areas in 1966 (URBN);

Source: These figures were taken from U.S. Census Bureau, Current Population Reports, Series P-25, no. 427 (1969).

19. Population density for states 1968 (PDS);

Source: The total resident population of each state was taken from U.S. Census Bureau, Current Population Reports, Series P-25, no. 437 (1970), and then divided by the state area.

20. Region of the country (D1, D2, D3);[1]

Source: The four U.S. Bureau of the Census regions were tested by dummy variable technique. The states were assigned to the four regions according to table 1.

TABLE 1

DISTRIBUTION OF THE 50 STATES BY GEOGRAPHICAL REGION

Northeast (D1)	South (D2)	North Central (D3)	West
Connecticut	Alabama	Illinois	Alaska
Maine	Arkansas	Indiana	Arizona
Massachusetts	Delaware	Iowa	California
New Hampshire	Florida	Kansas	Colorado
New Jersey	Georgia	Michigan	Hawaii
New York	Kentucky	Minnesota	Idaho
Pennsylvania	Louisiana	Missouri	Montana
Rhode Island	Maryland	Nebraska	Nevada
Vermont	Mississippi	North Dakota	New Mexico
	North Carolina	Ohio	Oregon
	Oklahoma	South Dakota	Utah
	South Carolina	Wisconsin	Washington
	Tennessee		Wyoming
	Texas		
	Virginia		
	West Virginia		